

**Arizona.**—Fort Grant, 4th; Fort Apache, 4th, 9th, 11th, 17th, 19th; Yuma, 11th; Prescott, 11th, 18th.

**Arkansas.**—Lead Hill, 7th.

**California.**—Fall Brook, 6th; Los Angeles, 11th, 18th; San Francisco, 16th, 17th, 19th.

**Connecticut.**—North Colebrook, 16th.

**Dakota.**—Fort Totten, 24th, 28th, 30th; Fort Meade, 25th; Fort Buford, 30th.

**District of Columbia.**—Washington City, 13th, 21st.

**Florida.**—Sanford, 10th, 19th; Archer, 19th.

**Georgia.**—Augusta, 20th.

**Idaho.**—Boisé City, 5th.

**Illinois.**—Riley, 1st, 16th, 19th, 20th, 26th, 29th; Chicago and Charleston, 16th.

**Indiana.**—Indianapolis, 5th, 16th; Laconia and Sunman, 16th; Logansport, 27th; Vevay, 28th.

**Iowa.**—Cresco, 6th, 19th; Monticello, 15th, 27th; Independence, 24th; Cedar Rapids, 24th, 26th.

**Kansas.**—Wyandotte, 1st, 4th, 5th, 7th, 9th; Yates Centre and Independence, 7th; Salina, 9th; Leavenworth, 19th; Manhattan, 28th.

**Kentucky.**—Frankfort, 20th.

**Maine.**—Cornish, 6th, 12th, 28th.

**Massachusetts.**—Blue Hill Observatory, 2d, 6th, 12th, 16th, 30th; North Truro, 3d, 12th, 13th, 20th, 30th; Amherst, 4th, 16th; Milton, 6th; Somerset, 6th, 12th, 16th, 28th, 30th.

**Michigan.**—Mottville, 1st, 5th, 16th; Lansing, 12th, 16th; Marquette, 16th; Alpena, 19th; Escanaba, 25th.

**Minnesota.**—Moorhead, 15th, 16th, 23d, 24th, 25th.

**Missouri.**—Saint Louis, 8th; Centreville, 10th, 22d.

**Montana.**—Poplar River, 3d, 14th, 30th.

**Nebraska.**—Brownville, 20th.

**New Jersey.**—Clayton, 15th.

**New York.**—Oswego, North Truro, and Palermo, 16th.

**North Carolina.**—New River Inlet, 2d, 5th, 12th, 17th, 21st, 24th.

**Ohio.**—Elyria, 2d; Wauseon, 2d, 3d, 6th, 15th, 26th.

**Oregon.**—East Portland, 3d, 4th; Albany, 16th; Roseburg, 16th, 26th.

**South Carolina.**—Stateburg, 3d; Spartanburg, 19th.

**Tennessee.**—Nashville, 5th, 20th, 27th.

**Texas.**—Abilene, 12th.

**Virginia.**—Dale Enterprise, 2d, 3d; Variety Mills, 2d, 3d, 11th.

**Wisconsin.**—Manitowoc, 15th; Delavan, 15th, 20th, 26th.

**Wyoming.**—Fort Bridger, 18th, 24th.

#### LUNAR HALOS.

Lunar halos were observed in the various states and territories during the month, as follows:

**Alabama.**—Mobile, 2d, 5th, 10th.

**Arizona.**—Maricopa, 3d, 6th; Yuma, 3d, 10th; Fort Grant, 3d, 11th; Wilcox, 7th, 11th; Fort Apache, 7th, 11th, 12th, 19th; Prescott, 8th, 9th, 11th, 12th.

**Arkansas.**—Lead Hill, 7th.

**California.**—San Francisco, 5th; Fort Bidwell, 10th; Oroville, 15th; Keeler, 17th.

**Colorado.**—Las Animas, 4th, 6th.

**Connecticut.**—North Colebrook, 3d; Bethel, 3d, 5th; New London, 9th, 12th.

**Dakota.**—Webster, 9th, 17th; Fort Totten, 10th, 11th; Bismarck, 10th, 14th, 15th.

**Florida.**—Pensacola, 2d; Cedar Keys and Manatee, 10th; Archer, 19th.

**Georgia.**—Forsyth, 7th, 20th; Augusta, 10th; Savannah, 13th.

**Idaho.**—Boisé City, 17th.

**Illinois.**—Springfield, 1st; Pekin, 1st, 3d, 11th, 18th; Riley, 1st, 5th; Chicago and Charleston, 16th.

**Indiana.**—Vevay, 1st, 8th, 10th, 14th, 15th, 20th; Terre Haute, 8th; Butlerville and Indianapolis, 8th, 14th; Laconia, 16th.

**Indian Territory.**—Fort Sill, 10th.

**Iowa.**—Clinton, 2d, 12th, 16th; Muscatine, 11th.

**Kansas.**—Wyandotte, 4th to 7th, 9th, 13th, 16th; El Dorado, Globe, Emporia, Salina, West Leavenworth, and Wakefield, 9th; Westmoreland, 9th, 10th, 30th.

**Kentucky.**—Frankfort, 2d; Louisville, 8th; Richmond, 10th.

**Louisiana.**—Shreveport, 2d, 10th.

**Maine.**—Orono, 8th; Eastport, 12th.

**Maryland.**—Emmitsburg, 6th; Baltimore, 11th.

**Massachusetts.**—Deerfield, 3d, 5th; Blue Hill Observatory, Milton, and North Truro, 16th.

**Michigan.**—Kalamazoo, 3d; Alpena, 5th, 15th; Lansing, 11th, 15th; Mottville, 12th; Escanaba and Mackinaw City, 15th.

**Minnesota.**—Moorhead, 8th, 14th to 17th; Saint Vincent, 29th.

**Montana.**—Helena, 14th; Fort Custer, 17th.

**Nebraska.**—Marquette, 2d, 14th; Omaha and Genoa, 14th.

**Nevada.**—Carson City, 10th.

**New Hampshire.**—Nashua, 12th, 16th, 20th.

**New Jersey.**—Beverly, 2d, 3d, 5th, 10th, 11th, 13th; Moorestown, 2d, 3d, 5th; Clayton, 2d, 5th, 8th; Dover, 3d, 5th, 11th; Upper Montclair, 9th.

**New Mexico.**—Fort Stanton, 4th; Santa Fé, 5th.

**New York.**—Rochester, 2d; Albany, 3d; Buffalo, 8th; Palermo, 9th; Ithaca, 9th, 16th; Brooklyn, 11th; Oswego, 15th.

**North Carolina.**—New River Inlet, 3d, 25th; Smithville, 5th; Lenoir, 10th; Charlotte and Statesville, 10th, 14th.

**Ohio.**—Wauseon, 1st, 2d, 11th; Toledo, 1st, 2d, 11th, 15th; Garrettsville and Hiram, 2d; Elyria, 2d, 4th; Napoleon, 2d, 11th; Cincinnati, 14th.

**Oregon.**—Roseburg, 11th, 30th; Albany and Mount Angel, 13th; Linkville, 16th.

**Pennsylvania.**—Pittsburg, 2d; Philadelphia, 2d, 5th; Dyberry, 2d, 5th, 9th; Grampian Hills, 2d, 11th; Fallsington, 3d, 5th; Catawissa, 11th.

**Rhode Island.**—Block Island, 11th.

**South Carolina.**—Spartanburg, 2d, 9th, 20th, 29th; Charleston, 9th; Aiken, 10th.

**Tennessee.**—Nashville, 8th, 10th; Memphis and Milan, 10th; Chattanooga, 14th, 27th, 29th.

**Texas.**—Palestine, 6th, 7th, 9th, 10th; Fort Davis, 6th, 10th; New Ulm, 9th, 10th; Corsicana, 10th; El Paso, 11th; Fort Elliott, 20th.

**Utah.**—Frisco, 11th.

**Vermont.**—Brattleborough, 6th.

**Virginia.**—Rappahannock, 1st, 3d, 11th; Dale Enterprise, 2d, 3d, 5th, 15th, 21st; Bird's Nest, 2d, 9th, 10th, 11th; Lynchburg, 3d, 5th, 6th, 9th, 10th; Cape Henry, 10th, 11th; Chincoteague and Norfolk, 11th.

**Washington Territory.**—Bainbridge Island, 10th; Port Angeles, 15th; Tatoosh Island, 17th.

**Wisconsin.**—Delavan, 5th, 6th, 15th; Beloit, 5th, 15th, 30th; Green Bay and Milwaukee, 15th.

**Wyoming.**—Fort Bridger, 13th, 14th, 18th.

The phases of the moon (Washington mean time) during November, as given in "The American Ephemeris and Nautical Almanac" for 1886, are as follows: New moon, 25th, 2 h. 10.3 m.; first quarter, 2d, 23 h. 57.0 m.; full moon, 11th, 1 h. 58.3 m.; last quarter, 18th, 5 h. 32.2 m.; apogee, 5th, 1.4 h.; perigee, 20th, 14.2 h.

#### MIRAGE.

Mirages were observed at the following stations:

Webster, Dakota, 11th.

Richardton, Dakota, 17th.

Salina, Kansas, 6th, 8th, 9th, 13th.

Marquette, Nebraska, 17th to 20th.

Reidsville, North Carolina, 14th, 18th.

#### MISCELLANEOUS PHENOMENA.

##### DROUGHT.

Mobile, Alabama: light rain fell during the 9th and 10th, breaking one of the severest droughts ever experienced in this

section, very little rain having fallen since June; the soil had become baked by the sun while roads and streets were very dusty. Numerous wells and cisterns had become dry and rivers were low.

Keokuk, Iowa: the light rain that fell during the 21st and 22d was of great benefit to farmers, many of whose cisterns and wells had become dry. Along the line of the Chicago, Rock Island, and Pacific Railroad many farmers have been obliged to haul water four or five miles for the use of their stock.

Milledgeville, Georgia: from August 2d to November 30th only 5.59 inches of rain have fallen, a deficiency of nearly twelve inches as compared with the average.

Clinton, Clinton county, Iowa: November and the four preceding months have been remarkable for the small precipitation.

Yates Centre, Woodson county, Kansas, 30th: the total precipitation of the month is only 0.10 inch, in consequence of which the soil is exceedingly dry.

The following extracts are from a report prepared by E. C. Brandenburg, Private, Signal Corps, U. S. Army, at Saint Paul, Minnesota, on the drought which has prevailed throughout the Northwest during the past summer and autumn:

#### THE DROUGHT OF 1886 IN DAKOTA AND MINNESOTA.

The severe drought which has prevailed over the western portion of the country during the summer of 1886 has left its devastating effects on the upper Mississippi valley and the Northwest. Its influence was mostly felt in northwestern Minnesota and northeastern Dakota, being most severe and longest in the latter section. Other areas which suffered for shorter periods were northern Iowa, western Wisconsin, southeastern Minnesota, southwestern Dakota, and eastern Montana.

This paper will treat mainly on its effects in Minnesota and Dakota.

In these states the usual copious rainfall of May was lessened so considerably that the drought literally began to be appreciable in that month. The temperature was abnormally high, with a deficiency in rainfall of nearly one inch.

In the month of June the temperature was about normal, while the precipitation was nearly one and a half inches below the average in Minnesota, and about two inches below in Dakota.

In July the rainfall continued below the average, with the greatest deficiency occurring in eastern Minnesota and southern Dakota. At Duluth, Minnesota, the deficiency was 2.42 inches; La Crosse, Wisconsin, 3.08 inches; Huron, Dakota, 3.26 inches; and Yankton, Dakota, 3.28 inches. The temperature in Dakota was decidedly above the normal, at Huron being 5°.4 above and Bismarck 6°.0 above. In Minnesota it was also above the normal, with the mean temperature of the state 72°.2, while the average of the minimum temperatures was 50°.5. The temperature was phenomenally high during nearly the entire month, while at Sherburne and Spring Valley the maximum temperature was respectively 107° and 104°, which is about the greatest heat ever observed in this state.

In August there was an excess of over two inches of rainfall in the southeastern portion of Dakota, while in northern Dakota and Minnesota the rainfall was below the average; the deficiency being 3.1 inches at Saint Vincent and 2.5 inches at Moorhead. The temperature continued above the average with the maximum above a hundred degrees north to Saint Vincent where it rose as high as 103°.2.

September in eastern Minnesota brought an excess of rainfall, while there was a deficiency in western Minnesota and northern Dakota. The temperature was markedly below the normal at Duluth, while it was slightly above in southeastern Dakota.

In October the rainfall was slightly below the average, while the temperature was decidedly above. For Minnesota the mean temperature was 8°.7 above the mean of the corresponding month of 1885. The greatest departures from the normal were 8° above at Duluth, 6° above at Moorhead, Saint Vincent, Saint Paul, and Yankton, and 5° above at Huron.

In the following table are given the mean temperature and average precipitation, with their normals and departures, as taken from the MONTHLY WEATHER REVIEW for five months:

Districts.	May.			June.			July.		
	Average for a number of years.	Average for 1886.	Comparison with other years.	Average for a number of years.	Average for 1886.	Comparison with other years.	Average for a number of years.	Average for 1886.	Comparison with other years.
Extreme Northwest:									
Temperature.....	52.4	55.8	+3.4	61.8	62.8	+1.0	66.5	71.1	+4.6
Rainfall.....	2.87	1.83	-1.04	3.41	2.50	-0.91	3.14	2.64	-0.50
Upper Mississippi valley:									
Temperature.....	62.8	64.3	+1.5	71.3	70.6	-0.7	75.6	76.8	+1.2
Rainfall.....	4.25	3.51	-0.74	5.60	3.63	-1.97	4.16	0.78	-3.38

Districts.	August.			September.		
	Average for a number of years.	Average for 1886.	Comparison with other years.	Average for a number of years.	Average for 1886.	Comparison with other years.
Extreme Northwest:						
Temperature.....	65.2	66.6	+1.4	54.5	52.5	-2.4
Rainfall.....	2.71	1.85	-0.86	1.99	1.96	-0.03
Upper Mississippi valley:						
Temperature.....	73.3	75.3	+2.0	64.6	65.9	+1.3
Rainfall.....	3.50	2.90	-0.60	3.67	4.85	+1.18

Pastures became burned and brown early in the season and caught fire readily from sparks of passing trains. Those crops which yielded fairly well were favored with early rains and were past danger when the dry season began. The effect on newly seeded grass fields has been unusually severe, in many cases rendering the seeding of early spring worthless. Tree seeds in northern Dakota have become very scarce and are in great demand.

Sloughs, lakes, and rivers, which had the appearance of having been in existence for ages, have become dry, leaving the alluvial soil found in their bottoms to be baked by the burning sun, thus causing it to be cracked over an inch wide and many inches deep in some localities. Regions where there was but a thin layer of soil upon a gravel or stone bottom suffered far more from the drought than those favored by ground of clay formation.

Prairie fires were much more frequent and did greater damage than in previous years. The removing of the grass covering from the earth by these fires exposed its surface to the direct rays of the sun, thus allowing undue absorption of the moisture from the soil and leaving it in a dry condition. In localities well favored with forests the effects of the drought were largely modified and showers were generally more frequent, thus showing the great necessity of protecting those woodlands which so materially assist in moderating droughts and floods. Rain was also more frequent near large bodies of water and along large streams.

During the fall of 1885 and winter of 1885 and 1886, the fall of snow and rain was very light, and was followed by a summer marked by a decided deficiency of precipitation, which had the effect of drying sloughs, lakes, and rivers to an almost unprecedented extent, causing the ground in many localities to be as dry as dust to the depth of eight or nine feet. This, together with the lack of water all through the West and Northwest, could supply the atmosphere with but little moisture to be precipitated. The universally high temperatures which prevailed added very materially to the injurious effects of the dry weather.

Were it not for the great number of lakes found in this region, there being 7,000 to 10,000 alone in Minnesota, with an average of three hundred and twenty acres and upwards, and the forests and woodlands which cover one third of the state, there is no doubt but that the damage would have been far greater.

In some localities there seems to be a period of increase and decrease in the amount of water in lakes and rivers, while in other localities there seems to be a yearly decrease in the amount of water. \* \* \*

In Minnesota the drought began in May and ended in August and September in the central and southern portions, while in the northern it continued quite severe until November 1st. In length it ranged from forty-one days in the southeastern portion of the state to over five months in the northern portion. \* \* \*

In Dakota the drought began generally during the latter portion of June and was still existing November 1st. It seemed more severe in the western portion of the state; Wells and Stark counties reported the rainfall to be far below the average since July, 1885. The state has also suffered severely from prairie fires which devastated vast tracts of land; in the northern portion of the state forest fires have done irreparable damage. In some portions of the state trees planted several years ago are in a flourishing condition, showing that timber can be grown and will prove valuable both as a commercial article and as an assistant preventive of drought.

#### FOREST AND PRAIRIE FIRES.

Shelbyville, Shelby county, Illinois: on the 4th, in Holland township, an area of forest and farm land four miles long and two wide was burned over. Many barns, fences, and fields of corn were destroyed; the loss of property is estimated at several thousands of dollars.

Hamburg, Berks county, Pennsylvania: on the 16th, 17th, and 18th an extensive forest fire prevailed in the Blue Mountains near the town; the dry leaves allowed the flames to spread rapidly and much valuable timber was destroyed.

Petersburg, Dinwiddie county, Virginia: on the 18th, 19th, and 20th extensive forest fires were burning along the line of the Wilmington and Weldon Railroad, destroying much timber and cord wood as well as other property.

Clarendon, Donley county, Texas: on the 29th extensive prairie fires were burning over the country about twenty miles northwest of this town; one hundred thousand acres of pasture were destroyed.

Forest and prairie fires have also been reported from the following places:

Moorhead, Minnesota: prairie fires, 5th, 6th, 8th, 9th, 10th, 12th, 13th, 16th, 17th.

Pike's Peak, Colorado: extensive prairie fires were seen on the northeastern horizon on the 1st.

Alva, Florida: forest fires, 1st.

#### METEORS.

Little Rock, Arkansas: on the 2d, at 6.20 a. m., a brilliant meteor was seen moving across the sky from east to west through a course of about thirty degrees in ten seconds. During its passage it constantly dropped violet and orange-colored balls of fire.

Vineyard Haven, Massachusetts: a very brilliant meteor was observed at 10 p. m. of the 4th about midway between the zenith and the western horizon; it moved 30°, leaving a distinct trail of light, which was visible for several seconds.

New London, Connecticut: a large meteor passed across the sky from southeast to northwest at 9.50 p. m. of the 4th bearing a trail of light, which was visible about forty-five seconds. This meteor was also seen at Sandy Hook, New Jersey, where it seemed like the sudden flash of an electric light; it was followed by a trail of yellowish light, and moved in a sinuous course from northeast to southwest; the meteor was visible for ninety seconds, and faded away gradually.

Hay Springs, Sheridan county, Nebraska: on the 7th a very brilliant meteor was observed in the northeastern sky at an altitude of about 14°, moving rapidly, and followed by a long trail. The meteor disappeared in the north when about five degrees above the horizon.

The observer at Keeler, California, makes the following report in regard to a meteor seen by him on the 12th:

A brilliant meteor was observed at 9 p. m.; when first seen the altitude was 59°, azimuth, 45°; when last seen, altitude 42°, azimuth, 47°. This meteor is worthy of special mention, it being unusually large and brilliant. It resembled a ball ejected from a Roman candle, but appeared to be about twice as large. The meteor in the centre was of a pale bluish tint, deepening toward the edge to a dark purple. The cloud in its wake was shaped like an elongated ellipse, and appeared to be composed of an infinite number of points of light.

Fall River, Massachusetts: at 5.30 p. m. of the 16th a fine meteor was seen to pass from the zenith to the west; it was followed by a bright trail of light and burst into brilliant flames. A meteor was also seen at 6.50 p. m. of the 27th, moving from the zenith toward a point north of west; the meteor was about the size of a cocoanut and was followed by a long trail.

Fort Grant, Arizona: a large meteor, apparent diameter five inches, was visible for ten seconds at 11.10 p. m. of the 27th. When first seen it was about 20° north of west, and at an altitude of 30°. The meteor was of a brilliant blue and was followed by a train of light of the same color, and about eight degrees in length.

Meteors were also observed in the various states and territories, as follows:

California.—Nicolaus, 13th; Keeler, 17th, 22d, 25th; Los Angeles, 22d.

Connecticut.—New Haven, 5th.

Dakota.—Webster, 17th, 18th, 20th.

Florida.—Archer, 8th.

Georgia.—Savannah, 20th.

Illinois.—Pekin, 7th; Anna, 15th; Windsor, 27th, 28th.

Indiana.—Logansport, 15th; Vevay, 24th.

Iowa.—Cedar Rapids, 6th, 18th, 22d; Monticello, 12th, 13th, 16th, 19th; Muscatine, 13th.

Kansas.—Wakefield, 5th, 6th, 29th; Emporia, 11th to 14th; Manhattan, 19th.

Kentucky.—Richmond, 8th.

Maryland.—Woodstock, 2d, 8th, 14th, 15th, 18th, 19th, 20th, 26th, 28th.

Massachusetts.—Dudley, 4th; North Truro, 16th; Somerset, 20th.

Michigan.—Kalamazoo, 3d.

Nebraska.—Hay Springs, 17th.

New Hampshire.—Nashua, 1st, 2d.

New Jersey.—Beverly, 1st, 2d, 4th, 20th; Dover, 4th.

New York.—North Volney, 2d; West Point, Fort Columbus, and Factoryville, 4th; Setauket, 22d.

North Carolina.—Charlotte, 2d.

Ohio.—Tiffin, 2d, 3d, 23d, 24th; Yellow Springs, 2d, 4th, 24th.

Oregon.—East Portland, 3d, 6th, 9th; Mount Angel, 8th.

South Carolina.—Spartanburg, 2d, 4th, 5th, 10th.

Texas.—Brownsville, 3d, 4th, 5th.

Utah.—Salt Lake City, 6th.

Vermont.—Poultney, 22d.

Virginia.—Dale Enterprise, 15th, 27th; Variety Mills, 29th.

Wisconsin.—Beloit, 3d, 5th.

#### MIGRATION OF BIRDS.

*Geese flying southward.*—Lead Hill, Arkansas, 4th; Little Rock and Fort Smith, Arkansas, 5th; Cape Henlopen, Delaware, 25th; Augusta, Georgia, 2d, 22d, 24th, 28th; Charleston, Illinois, 11th, 12th; Butlerville, Indiana, 3d; Fort Reno, Indian Territory, 5th; Muscatine, Iowa, 10th; Keokuk, Iowa, 14th; Cedar Rapids, Iowa, 17th; Independence, Kansas, 8th, 9th; Yates Centre, Kansas, 28th; Amherst, Massachusetts, 27th; Mottville, Michigan, 29th; Moorhead, Minnesota, 6th; Lamar, Missouri, 15th, 21st, 27th; Poplar River, Montana, 4th; Fort Assinaboine, Montana, 6th; New River Inlet, North Carolina, 19th; Kitty Hawk, North Carolina, 28th; Garrettsville, Ohio, 3d, 13th; Wauseon, Ohio, 7th; Linkville, Oregon, 5th, 8th; Wellsborough, Pennsylvania, 6th, 12th; Corsicana, Texas, 5th; Cape Henry, Virginia, 15th; Embarras, Wisconsin, 5th.

*Geese flying northward.*—Yankton, Dakota, 17th; Augusta, Georgia, 24th; Keokuk, Iowa, 13th; Independence, Kansas, 22d; Brownsville, Texas, 14th, 20th; Wauseon, Ohio, 5th; Linkville, Oregon, 11th; Chattanooga, Tennessee, 28th.

*Ducks flying southward.*—Fort Smith, Arkansas, 5th; Charleston, Illinois, 29th; Butlerville, Indiana, 27th; New River Inlet, North Carolina, 7th, 13th; Kitty Hawk, North Carolina, 17th, 28th; Wauseon, Ohio, 4th; Memphis, Tennessee, 6th, 16th; Cape Henry, Virginia, 17th.

#### POLAR BANDS.

Polar bands were reported from the following stations:

California.—Keeler, 9th.

Colorado.—Montrose, 6th, 17th, 18th, 23d.

Connecticut.—North Colebrook, 15th.

Florida.—Archer, 10th, 16th, 17th, 19th, 20th, 30th; Limona, 27th.

Illinois.—Riley, 4th, 11th, 20th.

Kansas.—Salina, 4th, 5th, 9th, 17th; Yates Centre, 8th, 30th; Ninnescah, 28th.

Massachusetts.—Somerset, 24th.

New Jersey.—Moorestown, 22d; Beverly, 28th.

New York.—New York City, 24th.

Ohio.—Wauseon, 11th, 19th; Napoleon, 11th, 16th, 20th, 26th.

Tennessee.—Nashville, 7th; Memphis, 20th.

Virginia.—Dale Enterprise, 11th, 16th.

Washington Territory.—Bainbridge Island, 18th.

Wyoming.—Prairie du Chien, 1st, 2d, 5th, 11th.

#### SAND STORMS.

Fort Assinaboine, Montana: on the 3d clear weather and high wind from the southwest and west prevailed; maximum velocity, forty-eight miles per hour, between 3 and 4 p. m. The gale was accompanied by clouds of sand which nearly obscured the sky.

Fort Buford, Dakota: on the 4th a heavy gale set in at 1 a. m. and continued until 6 p. m.; maximum velocity, fifty-two

miles per hour from the northwest, at noon. During the prevalence of the gale the air was filled with heavy clouds of dust and sand.

Keeler, California: on the 14th high wind set in shortly after 11 p. m. and reached before midnight a velocity of thirty miles per hour; the storm continued throughout the night and until sunset of the 15th; maximum velocity, thirty-nine miles per hour from the northwest, at 4.20 a. m. The storm raised great clouds of sand which nearly obscured the sky and rendered objects one-half a mile distant indistinguishable.

Sand storms also occurred at the following stations:

Yuma, Arizona, 10th, 15th, 16th.

Fort McDowell, Arizona, 15th, 21st.

Fort Yates, Dakota, 4th.

#### SUNSETS.

The characteristics of the sky, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service stations. Reports from one hundred and fifty-eight stations show 4,730 observations to have been made, of which one was reported doubtful; of the remainder, 4,729, there were 4,222, or 89.3 per cent., followed by the expected weather.

#### SUN SPOTS.

Prof. David P. Todd, director of the Lawrence Observatory, Amherst, Massachusetts, furnishes the following record of sun spots for November, 1886:

Date— November, 1886. Standard time.	No. of new.		Disappeared by solar rotation.		Reappeared by solar rotation.		Total No. visible.		Remarks.
	Gr'ps	Spots	Gr'ps	Spots	Gr'ps	Spots	Gr'ps	Spots	
2, 11 a. m.	0	0			0	0	0	0	
3, 9 a. m.	0	0	0	0	0	0	0	0	
5, 3 p. m.	0	0	0	0	0	0	0	0	
7, 12 m.	0	0	0	0	0	0	0	0	
8, 11 a. m.	0	0	0	0	0	0	0	0	
12, 12 m.	0	0	0	0	0	0	0	0	
14, 11 a. m.	0	0	0	0	0	0	0	0	
15, 3 p. m.	0	1	0	0	0	1	0	1	
19, 11 a. m.	0	0	0	0	0	0	0	0	
20, 1 p. m.	0	0	0	0	0	0	0	0	
22, 11 a. m.	0	0	0	0	0	0	0	0	
24, 12 m.	0	0	0	0	0	0	0	0	
26, 9 a. m.	0	0	0	0	0	0	0	0	
27, 1 p. m.	0	0	0	0	0	0	0	0	

Faculae were seen at the time of every observation.

#### VERIFICATIONS.

##### INDICATIONS.

The predictions for November, 1886, were made by 2d Lieutenant Frank Greene, Signal Corps, U. S. Army, Assistant, and were verified by 2d Lieutenant J. E. Maxfield, Signal Corps, U. S. Army, Assistant.

The detailed comparison of the tri-daily indications for November, 1886, with the telegraphic reports of the twenty-four hours for which the indications were prepared, shows the general average percentage of verifications to be 75.29. The percentages for the different elements are: Weather, 77.42; wind, 72.02; temperature, 73.44. By states, etc., the percentages are: For Maine, 70.86; New Hampshire, 72.69; Vermont, 72.75; Massachusetts, 72.36; Rhode Island, 74.53; Connecticut, 74.62; New York, 80.17; Pennsylvania, 76.22; New Jersey, 80.56; Delaware, 76.64; Maryland, 76.81; District of Columbia, 73.92; Virginia, 76.44; North Carolina, 82.39; South Carolina, 77.50; Georgia, 81.90; Florida, 79.92; Alabama, 75.89; Mississippi, 72.19; Louisiana, 76.28; Texas, 82.31; Arkansas, 72.47; Tennessee, 67.58; Kentucky, 70.25; Ohio, 76.78; West Virginia, 69.14; Indiana, 73.72; Illinois, 73.92; Michigan, 76.14; Wisconsin, 73.83; Minnesota, 73.56; Iowa, 76.58; Kansas, 76.17; Nebraska, 73.58; Missouri, 75.56; Colorado, 74.92; east Dakota, 73.50.

There were four omissions to predict, out of 9,630, or 0.04 per cent. Of the 9,626 predictions that have been made, seven hundred and seventy, or 8.00 per cent., are considered to have entirely failed; six hundred and eight, or 6.32 per cent.,

were one-fourth verified; 1,665, or 1.730 per cent., were one-half verified; 1,664, or 17.29 per cent., were three-fourths verified; 4,919, or 51.10 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

Below are given for the Pacific coast the percentages of indications for October, 1886; this data was prepared too late for publication in the October REVIEW. The predictions were made by 2d Lieutenant W. A. Glassford, Signal Corps, U. S. Army, Assistant; they were verified by 2d Lieutenant Frank Greene, Signal Corps, U. S. Army, Assistant. The percentages for the different districts are: Washington Territory, 72.44; Oregon, 70.44; northern California, 74.82; southern California, 77.32.

#### CAUTIONARY SIGNALS.

During November, 1886, the total number of signals ordered of all kinds, the verifications of which were determined, was three hundred and six, of these, two hundred and twenty-two, or 72.55 per cent., were fully verified both as to direction and velocity. Number of signals ordered for on-shore winds, one; verified, one. Number of signals ordered for northeast winds, thirty-six; verified both as to direction and velocity, twenty-four, or 66.67 per cent.; verified as to velocity only, seven, or 19.44 per cent. Number of signals ordered for southeast winds, sixty; verified both as to direction and velocity, forty, or 66.67 per cent.; verified as to velocity only, nine, or 15.00 per cent. Number of signals ordered for southwest winds, sixty-eight; verified both as to direction and velocity, sixty-one, or 89.71 per cent.; verified as to velocity only, four, or 5.88 per cent. Number of signals ordered for northwest winds, one hundred and eighteen; verified both as to direction and velocity, eighty-two, or 69.49 per cent.; verified as to velocity only, six, or 5.08 per cent. Number of signals ordered for winds without regard to direction, twenty-three; verified, fourteen, or 60.87 per cent. Number of signals ordered late, *i. e.*, after the verifying velocity had begun, four, or 1.31 per cent.

In forty-two instances winds were reported which would have justified the display of cautionary signals, but for which no signals were ordered, and in twenty-one instances winds which would have justified the display of on-shore signals, but for which no signals were ordered.

In addition to the above, six hundred and ninety-three signals were ordered at display stations, the verifications of which it was impracticable to determine.

#### COLD-WAVE SIGNALS.

During November, 1886, the total number of cold-wave signals ordered, the verifications of which were determined, was two hundred and forty-two; number verified, one hundred and ninety-three, or 79.75 per cent. Thirty-six signals were ordered, the verifications of which it was impracticable to determine. In addition to the above, in five hundred and thirty instances, the signals ordered from this office were repeated by the observers at the regular stations to towns in their vicinity. The verification of these it was impracticable to determine.

#### RAILWAY WEATHER SIGNALS.

P. H. Mell, jr., director of the "Alabama Weather Service," in the report for November, 1886, states:

The verification of predictions for the whole area was 80 per cent. for temperature, and 85 per cent. for weather.

The following corporations comprise this system: South and North; Montgomery and Mobile; Mobile and Girard; Georgia Pacific; East Tennessee, Virginia and Georgia system in Alabama; Memphis and Charleston; Columbus and Western; Atlanta and West Point of Georgia; Northeastern of Georgia; Western and Atlantic; East Tennessee, Virginia and Georgia system in Georgia; Montgomery and Eufaula; Pensacola and Selma; Pensacola and Atlantic; the cities of Milledgeville, Georgia, and Talladega, Alabama.

The following is from the "Bulletin of the New England Meteorological Society" for November, 1886:

Verification of weather signals at New Haven was 83 per cent. for temperature, 90 for weather; at five stations reporting to the Signal Office in Boston, 88.4 for temperature, 88.0 for weather. Local sunset predictions at Blue Hill for twenty-four hours from midnight were verified 77 per cent.; predictions at 8 a. m. for sixteen hours, 90 per cent. The Signal Service indications had a local verification of 70 per cent. Three cold-wave warnings were justified.